DOCUMENT RESUME

ED 267 788 IR 012 156

AUTHOR Rieber, Lloyd P.
TITLE The Effect of Logo on Young Children.
PUB DATE Jan 86
NOTE 38p.; Paper presented at the Annual Convention of the Association for Educational Communications and Technology (Las Vegas, NV, January 16-21, 1986). For entire proceedings, see IR 012 121.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Graphics; Geometry; Grade 2; Hypothesis Testing; Mathematics Instruction; *Microcomputers; Primary Education; *Problem Solving; Programing; *Programing Languages; Research Methodology; *Skill Development; Tables (Data); Teaching Methods
IDENTIFIERS AECT Research and Theory Division Meeting; Apple IIe; Instructional Effectiveness; *Logo Programing Language

ABSTRACT

This study was conducted to determine whether young children, given the experience of Logo programming, would acquire problem-solving skills and be able to transfer those skills to other areas. The study also investigated Logo's effectiveness in teaching certain fundamental geometric concepts to children who were supposedly not developmentally ready for such materials. Subjects included 25 second grade students from a public elementary school in New Mexico. Treatment consisted of each child receiving approximately 1 hour of Terrapin Logo programming on an Apple microcomputer each week for three weeks. The structure of the programming experience was based on a guided discovery approach; participants were allowed much freedom in their programming choices, yet they were motivated to pursue formal stage thought patterns using a carefully planned positive reinforcement technique. A problem solving measure and a geometric paper-and-pencil test were administered in a pretest-posttest design to the experimental group and to another second grade class in the same district which did not receive any Logo experience. The experimental group showed statistically significant results on both measures, while the control group showed no significant change on either. A list of references, one data table, and two appendices containing sample instructional materials and tests are provided. (Author/JB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
OERI
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official position or policy.

ED267788

THE EFFECT OF LOGO ON YOUNG CHILDREN

Lloyd P. Rieber

The Pennsylvania State University

Presented at the Annual Meeting of the Association for Educational Communications and Technology, Las Vegas, January, 1986

IR012152

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Michael Simonson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Abstract

In the Spring of 1983, twenty-five second grade students from a public elementary school in New Mexico had their regular curriculum supplemented with the experience of LOGO computer programming. This experiment studied the effectiveness of LOGO's turtle graphics in providing the subjects with a model of systematic thought which could be applied and measured in an adapted Piagetian problem solving activity. The study also investigated LOGO's effectiveness in teaching certain fundamental geometric concepts to children who were supposedly not developmentally ready for such material. The treatment consisted of each child receiving approximately one hour of Terrapin LOGO programming on the Apple microcomputer each week for three months. The structure of the programming experience was based on a guided discovery approach. The children were allowed much freedom in their programming choices, yet they were motivated to pursue formal stage thought patterns using a carefully planned positive reinforcement technique. Data from the experimental group were compared to another second grade classroom in the same district which did not receive any LOGO experiences. The experimental group showed statistically significant results in both the problem solving measure and geometric pencil and paper test. The control group showed no significant change in either case.

The Effects of LOGO on Young Children

Introduction

The introduction of the LOGO programming language to mainstream education in the late 1970's and early 1980's received much attention and initial praise. Even though not much was known empirically about the use of LOGO with children (Watt, 1982), it was nonetheless brought into many classrooms across the country with rushed excitement. Many educators facing the responsibility of utilizing the growing microcomputer medium turned to this innovative concept with the hope of providing children with a suitable and profitable educational experience. In lieu of the research and field-test data, many educators took the word of a small group of scientists and theorists at the Massachusetts Institute of Technology (MIT) that children's exposure to LOGO could possibly yield favorable results in thinking and mathematical ability. Furthermore, it was contended that these results would be best achieved given a revolutionary break from the traditional, and often admonished, teacher dominated classroom and proceed to a highly child centered environment (Papert, 1980). This educational bandwagon was further encouraged by the public's insistence that education begin to prepare its youth for the already present computer age. These factors, among others, have contributed to LOGO's somewhat ubiquitous reputation as being possibly the most significant educational software of the decade (Lough, 1983).

Confirming evidence of LOGO's ultimate educational value was expected from some of the early LOGO projects such as the Brookline, Massachusetts project and the Lamplighter project in Dallas. Unfortunately, these projects did not provide educators with convincing evidence of LOGO's potential and the

argument for and against LOGO continued. Recently, however, the findings from several large LOGO projects, such as the Bank Street College Project in New York and the University of Israel Project, have cast rather dark clouds over the LOGO landscape. These studies attempted to present LOGO to children in the context of free or open discovery learning as advocated by Seymour Papert, LOGO's principal developer. In these studies, LOGO failed to show any significant contribution to the children's problem solving or mathematical skills (Pea, undated; Leron, 1985). In another study completed at the University of Edinburgh, Scotland, LOGO was presented in a more traditional and structured way. LOGO was substituted for the regular mathematics curriculum and was taught in a structured, teacher directed way. Here again, LOGO did not provide a superior learning environment over non-LOGO instructional methods: students in the LOGO group did not perform significantly better on math achievement tests than non-LOGO math students (Howe, O'Shea & Plane, 1979). These results, and in particular, the results from the Bank Street College of Education "raise serious doubts about the claims made for the cognitive benefits of learning to program, particularly in LOGO" (Pea, undated, p. 30-31). These results have prompted many educators to call for a halt in the use of LOGO and LOGO-like experiences in the classroom (Tetenbaum & Mulkeen, 1984). These studies support a contention that LOGO has failed to deliver what it had promised.

In response to these criticisms, Papert has emphasized that LOGO never promised anything. Instead, he supports the view that LOGO is part of a cultural influence. Considering LOGO by itself, without associated cultural factors, is devoid of meaning (Papert, 1985). This is why, according to Papert, it is fruitless to try to control for the "LOGO variable" in experimental type research.

Papert's criticism, although perhaps valid to a certain extent, leaves the concerned educator in a type of "damned if you do and damned if you don't" situation. Educators who try to understand Papert's perspective and attempt to aspire to the potential of LOGO find themselves confronted with unimpressed curriculum supervisers demanding supportive data whereas researchers are accused of contaminating a good idea with their experimentation techniques. Ultimately, educators will need to have an objective measure of the possible influences of LOGO and LOGO-like experiences on their students in order to justify continuing or abandoning the cause. These decisions will need to be based, at least in part, on information gathered through experimental research.

Purpose

The purpose of this paper is to present and discuss a relatively recent study involving the experiences of young children who used LOGO over a three month period. The purposes of the study were two-fold. First, it has been claimed that people who engage in LOGO programming, or other similar languages for that matter, are apt to better develop problem solving abilities (Papert, 1980) due to the nature of the programming tasks. Programming with LOGO, it is contended, supports a systematic structure of procedural problem solving where large problems are broken down into smaller, more manageable "chunks". This study sought to investigate whether or not young children, given the experience of LOGO programming, would acquire more problem solving skills and be able to demonstrate those skills in other problem solving contexts.

The second problem investigated and discussed here concerns the potential of learners to gain incidental mathematical insight and ability through their LOGO programming experiences. These skills are termed incidental because they are not taught directly by the teacher, but are acquired

as a by-product of the total programming experience. The rationale behind this is based upon the structure of LOGO itself. The language of LOGO is a language where mathematics is communicated between the learner and a small cybernetic animal called the "turtle". The learner, in his/her physical world, and the turtle in its, share many important traits. The two most important traits that they share are position and heading making the turtle body syntonic with the child (Papert, 1980). In addition, since the child is able to identify with the turtle through these physical associations, Papert contends that the child and the turtle begin to share a type of cognitive bond. This bond, or ego syntonic relationship, allows the child to project his/herself according to the perspective of the turtle. It is through these means that the child is believed to be able to gain mathematic insight not readily attainable through traditional means. This belief becomes even more interesting when the learners are especially young, as in the second grade. According to the child development theories of Piaget, the preoperational or concrete operational child does not view the world as being filled with rigid and fixed shapes. Rather, the child views the world with a more topological perspective where lines and angles are permitted to bend and flex (Copeland, 1979). Therefore, the second problem to be discussed here is whether or not young children are able to assimilate some basic geometric concepts and the notion of perspective and rigidity even though their cognitive development dictates a more topological viewpoint.

Methods

Subjects

Subjects in the experimental group consisted of 25 second grade children from a regular, public school classroom. The experimental group consisted of 15 boys and 10 girls with ages ranging from seven to nine years with a mean age of 8.08 years. The control group also consisted of an intact, second grade

classroom. This group was from a different school in the same school district. The control group consisted of 22 children: 11 boys and 11 girls whose ages also ranged from seven to nine years with a mean age of 7.82 years. The rationale for using a control group was based upon the need to control for maturation effects of the experimental group (Campbell & Stanley, 1963). The experimental and control groups were selected based in part upon the willingness of their teachers to participate and other more restraining factors typically found in field-based research which prevented random assignment of subjects to the treatment groups.

Materials

The treatment given to the experimental group was the experience of programming a microcomputer in the computer language of LOGO. Each subject received approximately one hour of LOGO programming each week using the Terrapin version of LOGO on the four available Apple II+ microcomputers. These four microcomputers were also used by the rest of the school's population. Since this study was conducted within the confines of a public elementary school it was therefore subject to all of the limitations inherent in this type of setting. Although this quasi-experimental design makes proper control of experimental variables more difficult, there are some merits to be considered. For example, the LOGO learning environment created here is probably not much different from those to be found in schools all across the country and thus the results can probably be more easily generalized to current classrooms.

The LOGO Learning Environment

Initially, the LOGO experience presented to the experimental group was planned to conform to Papert's "free discovery" or humanistic style philosophy where the teacher acts as a facilitator rather than a fact giver. In this type of setting, a teacher who is well acquainted with the programming or "nuts and

bolts" aspects of LOGO acts as a facilitator giving the child advice, informative feedback, technical assistance and other "on-task" information whereas the child's role is to take an individual learning path with the responsibility of generating ideas as well as the bulk of the creativity. Shortly after the treatment began, however, it became very obvious that the subjects would require much more time than the three months allotted to even begin to attain the programming level thought necessary for any significant differences to be detected. For this reason, it was necessary to develop a way to motivate the subjects to progress in a quickened, yet consistent, way. So instead of allowing the children to explore with the turtle with total freedom, as Papert advocates, a different approach was used which still provided the children with much freedom.

A series of activity cards was prepared. On each card was a simple shape, such as a square. If the child successfully recreated the shape on the computer's monitor, then a "chance slip" was rewarded. This chance slip was put into a jar which was later used to draw for prizes. The more chance slips in the jar at the time of the drawing, the better the chance to win a prize. The shapes on the cards were then made increasingly more complex. The skills learned on one card might be prerequisite on another. (Copies of selected activity cards can be found in Appendix I.) This building block method of skill development along with the reward system proved to be extremely successful. The children were not forced to complete the activity cards, just merely coaxed. Many times a chance slip was awarded if the child would try to alter something in their design according to the instructor's directions. This was done to help the child achieve a concept which otherwise would have been missed. This "guided discovery" technique has worked well in this and in other LOGO environments occurring in typical school situations.

After the child successfully completed several activity cards with little difficulty, the child would be encouraged to combine these shapes to make a larger figure. Any figure created by the child which was composed of activity card shapes was also awarded a chance slip. This encouraged the children to record successful programming code in a notebook. The code for several single shapes was often used with little modification when joined together to create the macro design.

The control group received no such LOGO exposure or any microcomputer experience for that matter during the time of the study. Although the two groups had different teachers, it must be restated that both were in the same school district and therefore both received similar instruction in terms of content since both classrooms had similar classroom materials apart from the computer experience, such as identical textbooks and district objectives.

Dependent Measures

Evaluation of LOGO in classroom or other settings has been controversial among LOGO's promoters and critics. Although LOGO enthusiasts tend to reject the notion of testing in any LOGO microworld, the problem of objective evaluation remains. Justifying the inclusion of any major curriculum component requires accounting for supposed educational gains in clear, objective terms. LOGO's effectiveness and potential learning and instructional benefits appear to be centered in two areas: problem solving and mathematics. These two areas closely resemble the distinction between crystallized and fluid intelligence as described by Catell (1971). An objective of this study was to examine a possible evaluation procedure of LOGO which considers these two facets of intelligence.

There were two dependent measures used in this study. The first was a measure of problem solving ability in two parts and the second was a paper and

pencil geometry test. Both measures were administered by the researcher to the experimental and control groups in a pretest/posttest design.

The problem solving measure is a quantitatively derived form of two classical Piagetian activities used originally as examples of problem solving in individuals at the stage of formal operations. This measure was presented individually to each subject in each treatment group in two parts. One part involved a combinatorial task and the other a permutation task. These tasks were chosen as a possible solution to the conflict of evaluating problem solving due their historical use as relative indices of formal thought in Piaget's Theory of Intellectual Development (Copeland, 1979). These tasks were then supplied with a scoring technique which would allow them to be statistically analyzed.

In the combinatorial activity, the child was shown six piles of different colored markers. The task was to arrange the markers in as many combinations of pairs as possible. It was strongly emphasized by the researcher to the subjects that no repeated combinations could be permitted. All discovered combinations of the possible 15 were scored one point each. However, one point was subtracted for each combination repeated by the child. Fifteen points was the highest score possible with the lowest possible score being zero.

Each subject was instructed to complete the task involving permutations in a similar fashion. The child was shown four piles of different shapes: squares, triangles, stars, and circles. The task here was to remove one shape from each pile and then arrange the four shapes in a different way from all previous trials. Again, it was emphasized to the child that all of the arrangements must be found with no repeats permitted. The scoring technique here was identical to the combinatorial activity: repeated arrangements were

subtracted from the total sum of identified permutations with 24 being the highest possible score and zero the lowest.

Each subject's raw score for this measure was the sum of the combinatorial and permutation tasks.

The measure of geometric concepts was administered in a group setting to each of the treatment groups with measurement tools such as rulers and protractors provided. The test consisted of four pages (see Appendix II). Page one consisted of an angle recognition activity where the child was instructed to select the proper angle from a group of four. Page two also dealt with the concept of the angle. The subjects were given an angle and one ray of another angle. The subjects were instructed to draw the second ray in such a way that the angle formed would match the given angle identically. Additionally, the given rays were offset somewhat from the given angles so that the child had to consider the task from a different perspective. Page three dealt with the measurement of line segments. One line segment was given with the child being told to draw another line of exactly equal length. The starting point for the child's line was given and offset in such a way as to require the child to demonstrate conservation of length. The fourth page also dealt with the concept of the angle. Here the child was instructed to imagine rotating a given figure a certain number of degrees left or right and then to point to the direction in which it would be facing. This task resembles more closely the activity actually involved in LOGO programming. Whereas the first three geometry test pages attempted to measure far transfer of LOGO's mathematical model, the fourth page was designed to measure one near transfer component.

Analysis of the Data

Problem Solving

An analysis of the experimental and control groups' pretest means, 11.52

and 11.27 respectively, on the problem solving measures using an independent t test show that the two groups means were statistically similar, $t(45) = -.1588$, $p<.01$ in problem solving ability at the onset of the study. (See table 1 for the groups' descriptive statistics.)

The experimental and control group's posttest means were 17.6 and 10.59, respectively. The analysis of these means using an independent t test showed a highly significant difference, $t(45) = 4.87$, $p<.01$. Therefore, the null hypothesis can be rejected and the conclusion drawn that these means are statistically different.

An additional analysis comparing the pretest and posttest means of each group using dependent t tests also support the above conclusion (although this is not the preferred statistical technique). An analysis of the experimental's pretest and posttest means show a highly significant difference, $t(24) = 4.9$, $p<.01$, whereas an analysis of the control group's pretest and posttest means show no significant difference, $t(21) = -.5718$, $p<.01$.

Insert Table 1 About Here

Geometric Mathematical Ability

As in problem solving measure, the experimental and control groups were determined to be at similar levels of geometric mathematical ability at the start of the study as determined by an analysis of their pretest means, 11.4 and 11.73 respectively. An analysis of these data using an independent t test show no significant difference, $t(45) = .4024$, $p<.01$.

The experimental and control group's posttest means were 14.8 and 12.5,

respectively. A comparison of these means using an independent t test showed a moderately significant difference, $t(45) = 1.78$, $p<.1$.

The additional analysis of the experimental group's pretest and posttest means using the dependent t test show a significant difference, $t(24) = 3.21$, $p<.01$, whereas the control group showed no such difference, $t(21) = .9287$, $p<.01$.

General Discussion

The findings of this study tend to support the hypotheses and general educational philosophy of LOGO's developer, Seymour Papert, in two important ways. First, the group of children who used LOGO in this study performed better on the problem solving measures than the group of children who received no such LOGO programming exposure. This is consistent with Papert's conjecture that successful programming interactions encourage the development and exercise of problem solving strategies. These results give evidence that these strategies might be able to transfer beyond the context of computer experiences. These results in the area of problem solving are in stark contrast to many of the findings reported by the Bank Street College researchers and the University of Israel researchers. Second, the LOGO programming group appeared to gain mathematical insight to certain geometric tasks merely by their LOGO programming experience, whereas the non-LOGO group did not change significantly during the three months in which the study took place. These geometry aptitude findings presented here appear to contradict the findings from the University of Edinburgh work. Furthermore, these results were obtained in a very young group of children and were the result of direct computer programming interactions, i.e. no supportive non-computer instruction was provided.

One difference between previous studies and the one presented here

which might help to explain the inconsistencies concerns the learning environment in which the LOGO programming took place. This study presented LOGO in a "guided discovery" environment where although the teacher played an important role in the learning paths taken by the students, there was still an enormous amount of freedom for the students to experiment with the LOGO microworlds. This possible explanation is supported by findings of another LOGO study in which a guided discovery environment was also encouraged. The experimental group in this study, conducted at the California Polytechnic Institute of California, also showed significant mathematical gains (Cron, 1983). Although it was not the intention of this research to examine the attributes of successful LOGO learning environments, this insight should be considered by current teachers in the planning of computer education experiences which will involve LOGO.

Although the experimental group showed a significant increase in their problem solving ability as measured by the combinatorial and permutation activities, one question which must be asked is whether or not this difference is important. It would be a naive conclusion to state that any single measure could evaluate something as complex as the construct of problem solving. Attempting to evalute problem solving or systematic thought using a single measure is analogous to holding a highly detailed object in front of a bright light and then studying its shadow on the wall; the shadow gives the observer only the faintest notion of the object's complexity. Therefore, since these results show much promise for LOGO's ability to present a problem solving model to learners, much more research is needed. These results show that learners who use LOGO appropriately and regularly appear to gain incidental problem solving aptitude, that is, the problem solving ability gained is the result of the programming experience, not as the result of direct teaching.

Other studies have shown that there are more efficient ways than LOGO to increase problem solving in children (Dalton, 1985). Yet, since this increase in problem solving ability is in addition to other assumed benefits, learning efficiency does not play as important a role.

Another important issue is given the fact that LOGO programming does in fact increase systematic thought, is this effect desirable? LOGO appears to be an obvious answer to what Piagetians term the "American question", which asks if it is possible to intentionally hurry children through their developmental stages. Papert has speculated that if computers and programming eventually become part of the cultural fabric, that one consequence might be that children's cognitive development might be hastened, especially between the concrete and formal operational stages (Papert, 1980). Regardless of the answer to this "question", one should consider David Elkind's (1981) interpretation of childhood where ". . . it is important to see childhood as a stage of life, not just as the anteroom of life" (p. 199). Each stage should be given equal value in the development of the being, rather than merely interpreting cognitive development as a "race" to be won. The responsibility of research is to investigate these speculations in order to provide objective ways in which to make appropriate decisions, whether instructional or societal, on the behalf of the individual.

Implications for Future Research

In contrast to Papert's criticisms of experimental research involving LOGO as a treatment variable, several recommendations for future research are to be made. The first concerns the possible treatment interactions involving the learning environment in which LOGO is presented to children. Considering the results presented here as well as the findings from the Bank Street College of Education, the University of Israel, and the University of Edinburgh, it is

implied that LOGO's success is heavily dependent upon the learning context. This learning context would include the physical elements such as the number of computers and the time on task, but most importantly the basic method of interaction such as free discovery, guided discovery, or highly structured. Future research should center on the effects that these different LOGO learning contexts have on the child's cognitive growth. Certainly, future research should also consider the individual learner characteristics and the role that these differences play in determining the proper LOGO environments.

It has been pointed out that there presently exists a unique opportunity for computer education research (Lepper, 1985). As computers begin to become a part of our daily lives, it will be difficult to find subjects who have not had prior computer experiences. Without such subjects, finding an appropriate control population will not be possible. This fleeting computer "research window" could be viewed as similar to the history of research in educational television. The obvious conclusion is that researchers need to act upon this research opportunity before it disappears.

This study has raised several questions concerning the learning effects of LOGO on young learners. It is hoped that further research will continue to clarify situations where using LOGO is appropriate as well as inapropriate. Most importantly, more research appears warranted and needed in this realm of computer education.

References

Campbell, D. & Stanley, J. (1963). Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally & Company.

Cattell, R. (1971). Abilities: their structure, growth, and action. Boston: Houghton Mifflin.

Copeland, R. (1979). How children learn mathematics. New York: MacMillan Publishing Company.

Cron, M. (1983). Trouble in Logoland. Teaching, Learning, Computing. December, 59-65.

Dalton, D. (1985). A comparison of the effects of LOGO and problem solving strategy instruction on learner achievement, attitude and problem solving skills. Unpublished Doctoral Dissertation. University of Colorado, Boulder.

Elkind, D. (1981). The hurried child: growing up too fast too soon. Reading, Massachusetts: Addison-Wesley Publishing Company.

Howe, J., O'Shea, T. & Plane, F. (1979). Teaching mathematics through LOGO programming: an evaluative study. DAI Research Paper No. 115, September.

Lepper, M. (1985). Microcomputers in education. American Psychologist, 40(1), 1-18.

Leron, U. (1985). LOGO today: vision and reality. The Computing Teacher, February, 26-32.

Lough, T. (1983). LOGO: discovery learning with the classroom's newest pet: part I. Electronic Learning, 2, 49-53.

Papert, S. (1980). Mindstorms: children, computers, and powerful ideas. New York: Basic Books, Inc.

Papert, S. (1985). Computer criticism vs. technocentric thinking. LOGO 85 Theoretical Papers, 1, July.

Pea, R. (undated). LOGO programming and problem solving. Center for Children and Technology, Bank Street College of Education, Technical Report No. 12.

Tetenbaum, T. & Mulkeen, T. (1984). LOGO and the teaching of problem solving: a call for a moratorium. Educational Technology, November, 16-19.

Watt, D. (1982). LOGO in the schools. BYTE, January, 116-134.

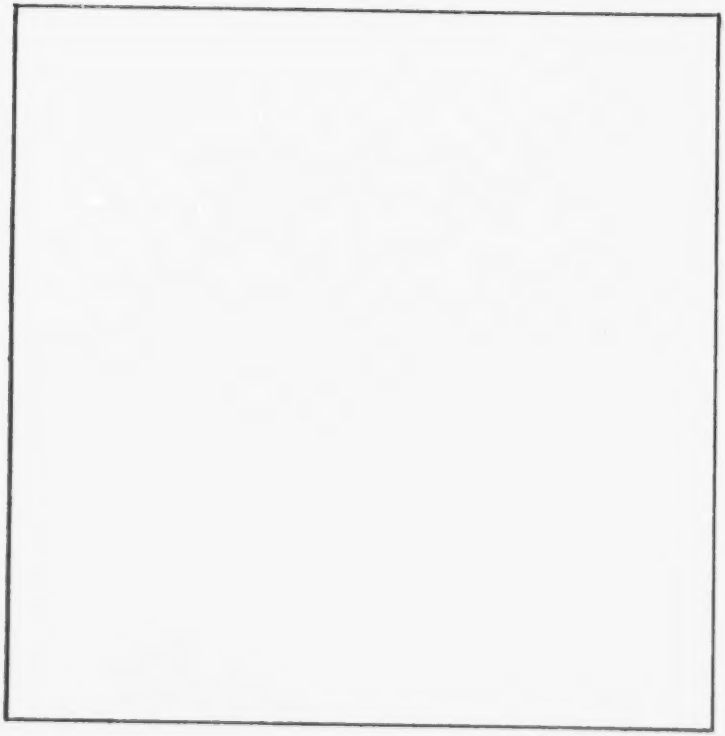
Table 1. Descriptive Statistics of Treatment Groups

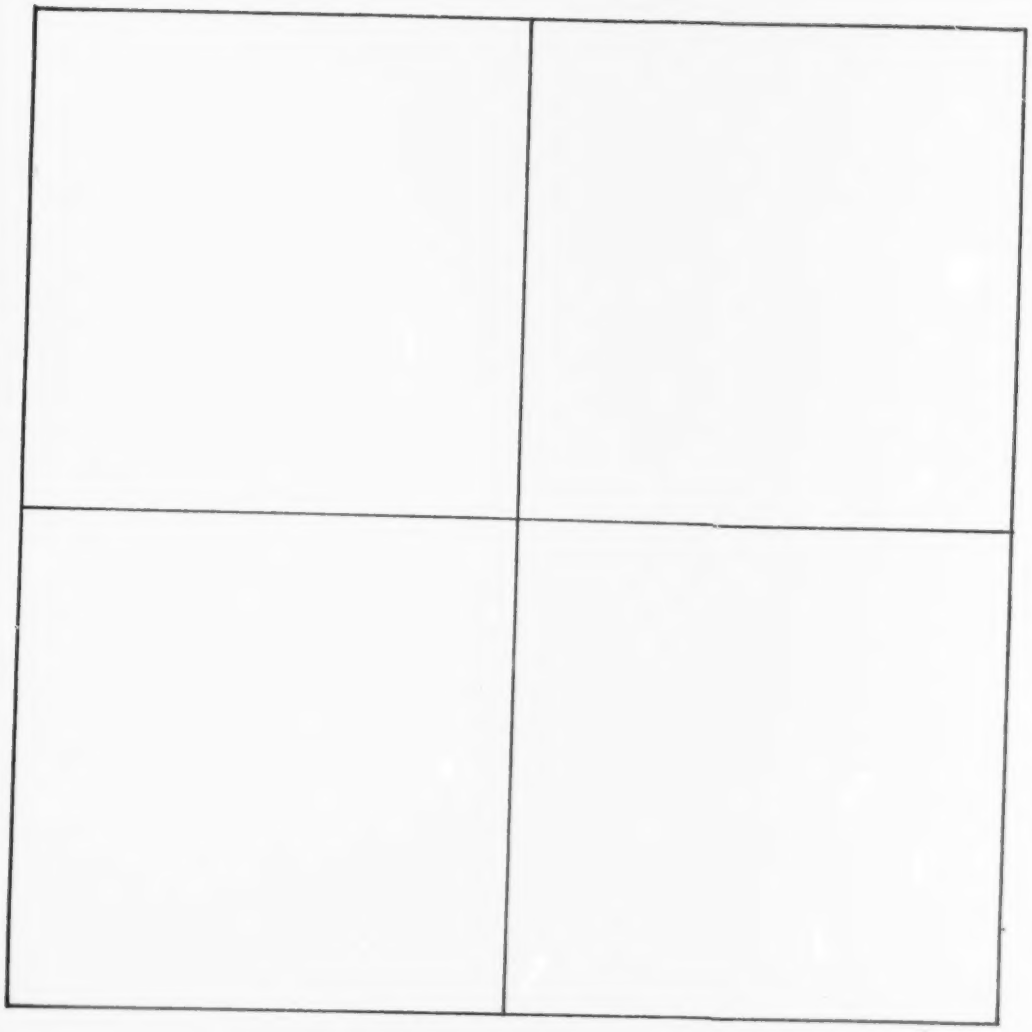
	Experimental	Control
Number of Subjects	25	22
Problem Solving		
PRETEST MEAN	11.52	11.27
(SD)	(5.92)	(4.55)
POSTTEST MEAN	17.6	10.59
(SD)	(5.11)	(4.45)
Geometry Test		
PRETEST MEAN	11.4	11.73
(SD)	(2.57)	(3.01)
POSTTEST MEAN	14.8	12.5
(SD)	(4.88)	(3.56)

APPENDIX I

SQUARE

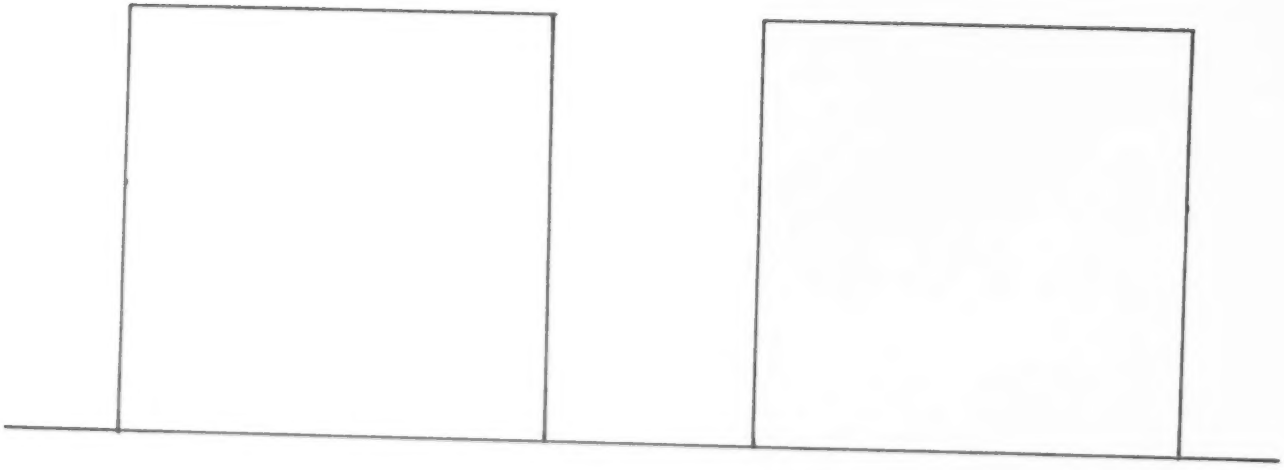
All 4 sides are equal.
All 4 angles are equal.

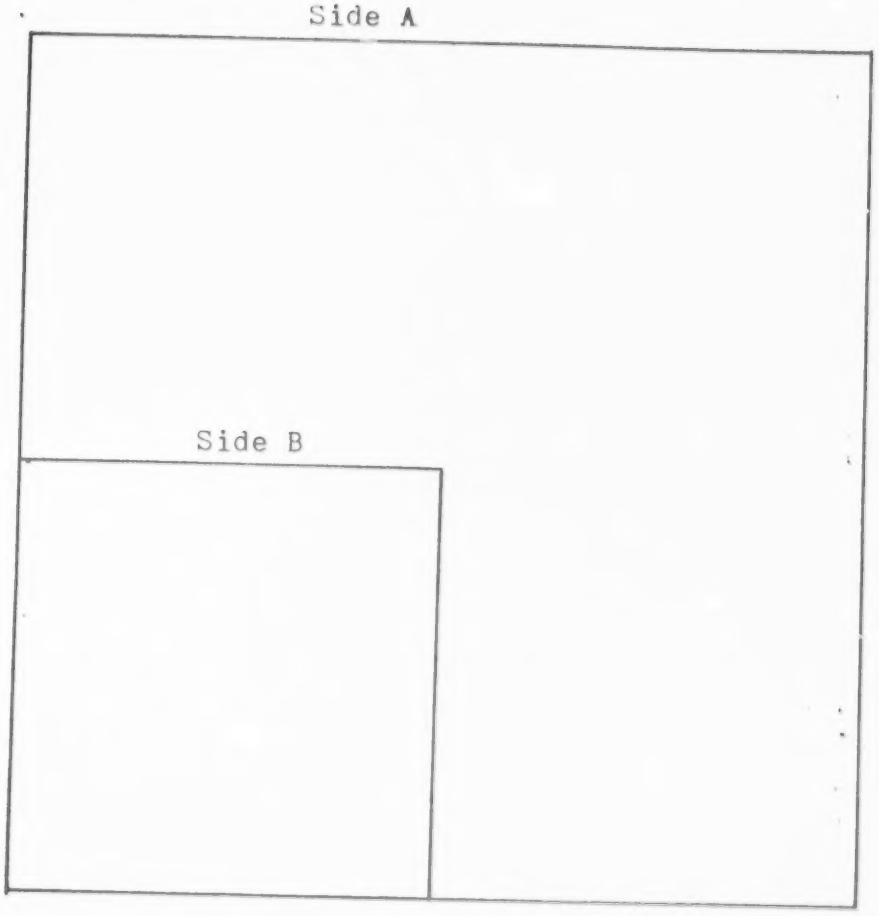




The 4 little squares make 1 big square.

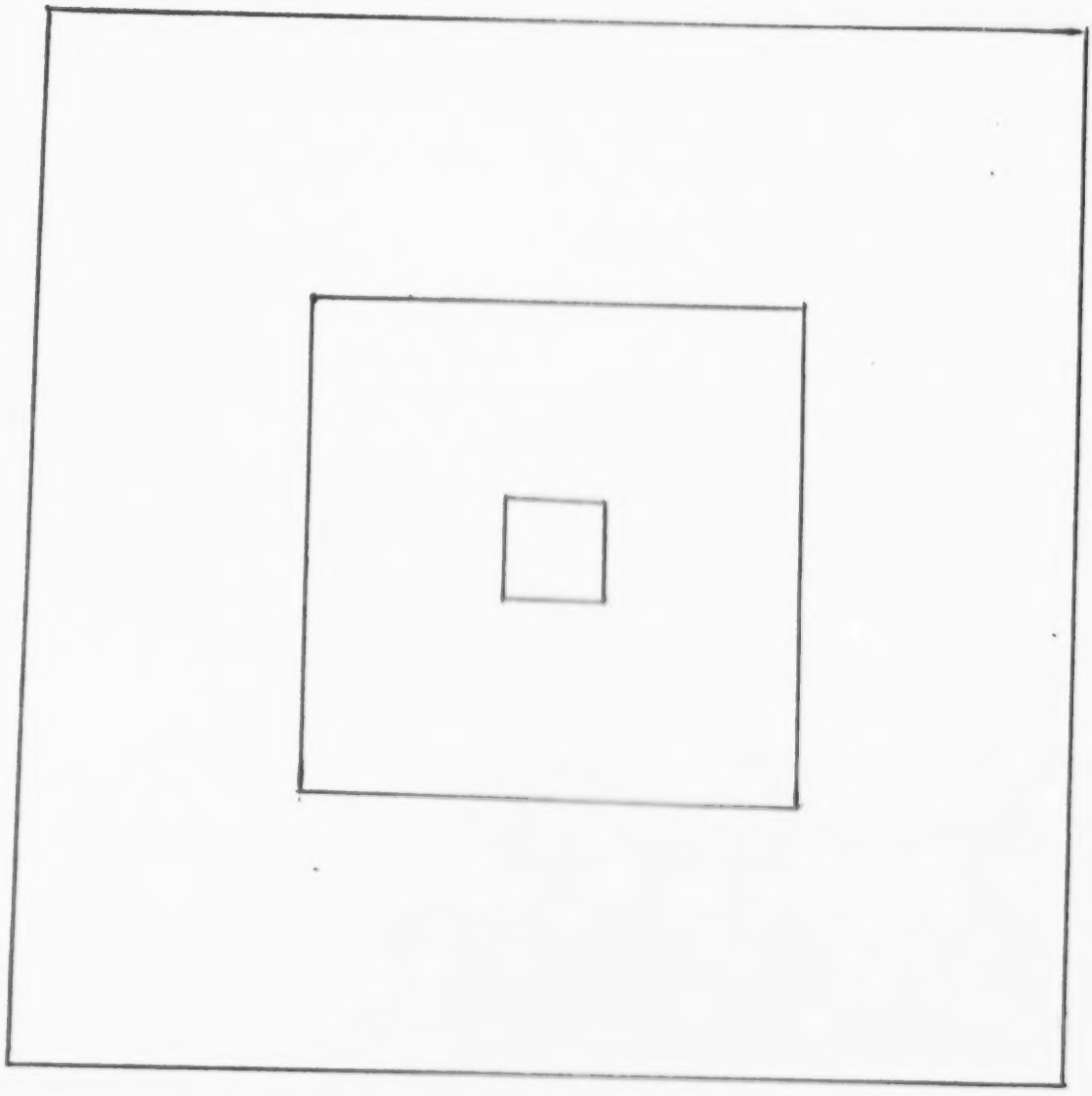
Both squares are exactly the same size.



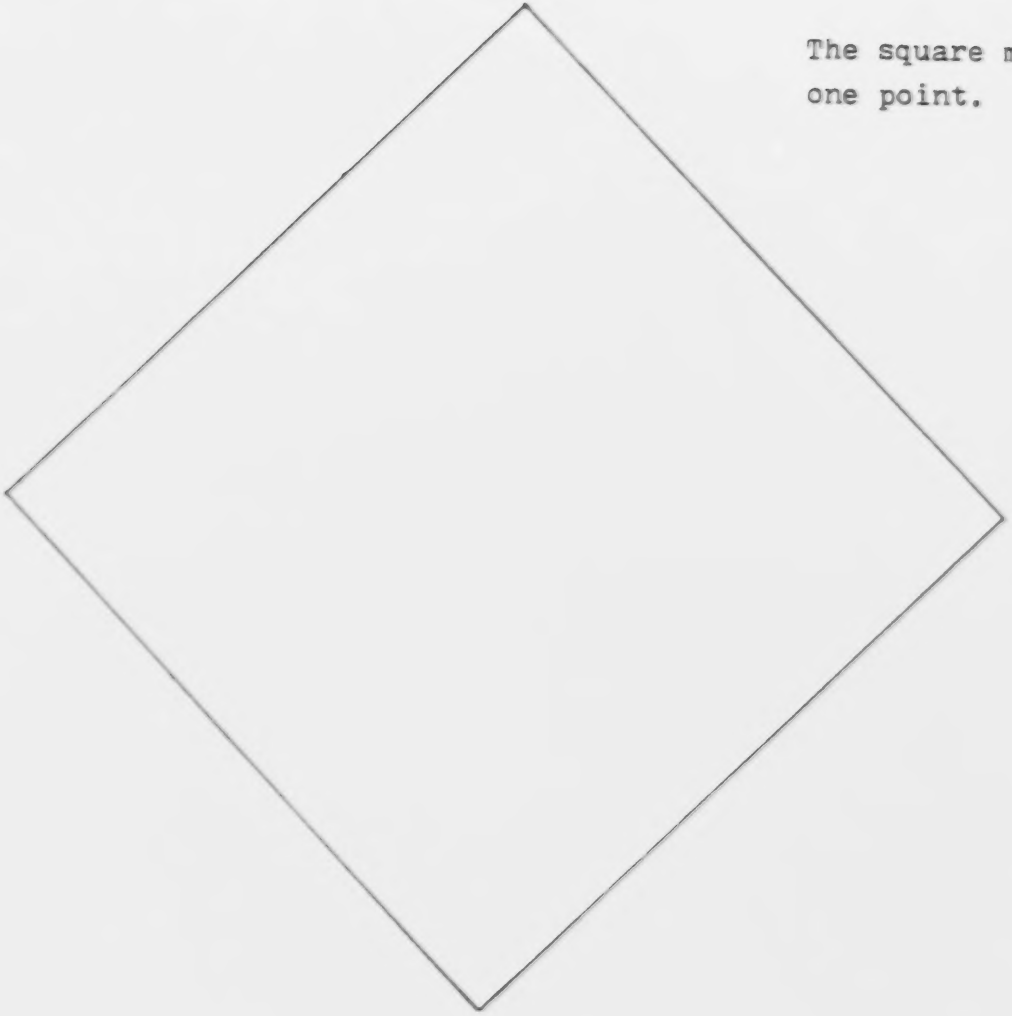


Side A is exactly twice as long as Side B.

All 3 squares have the same middle.

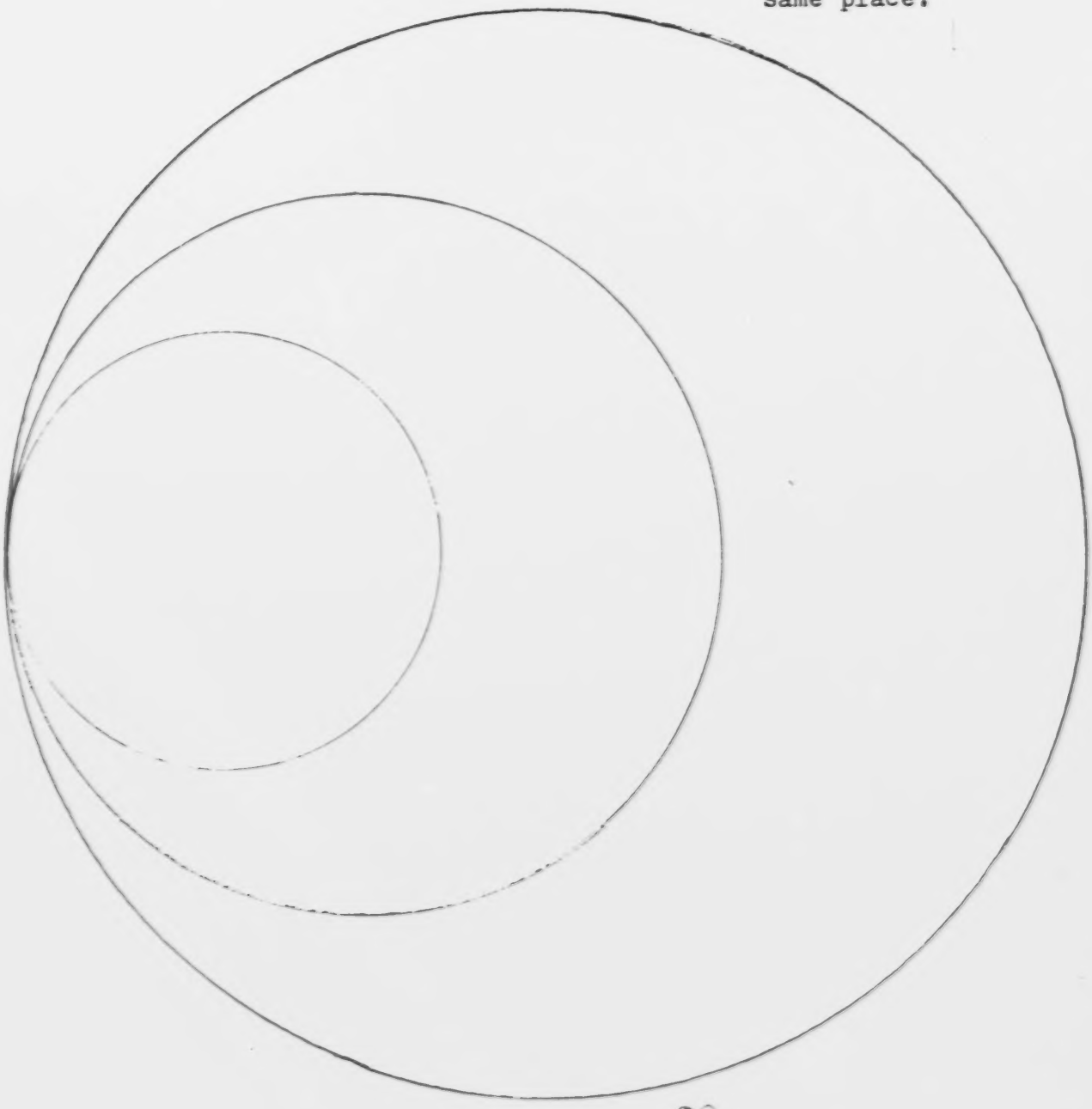


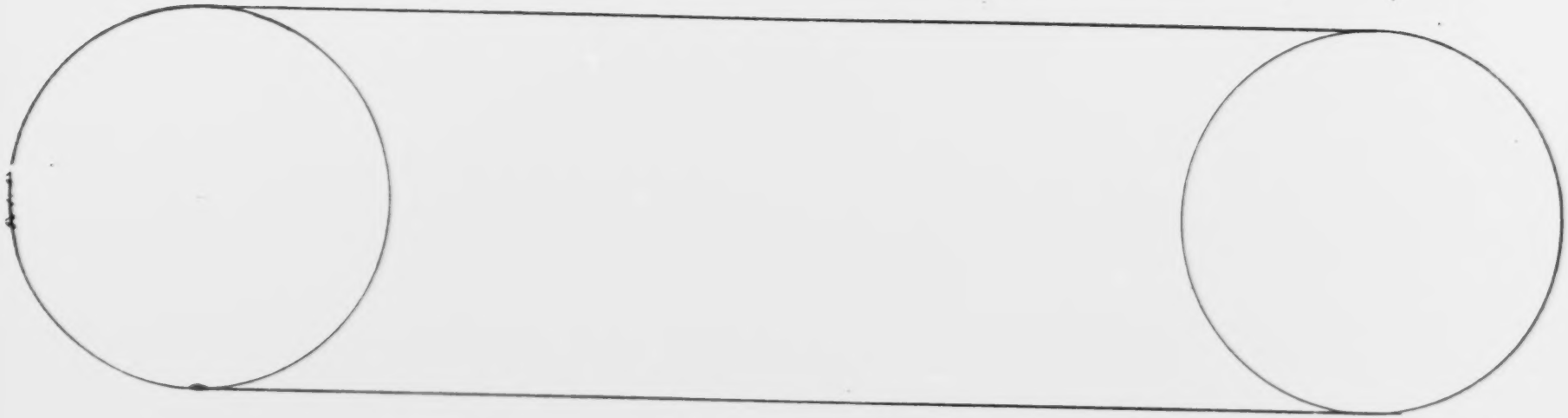
DIAMOND



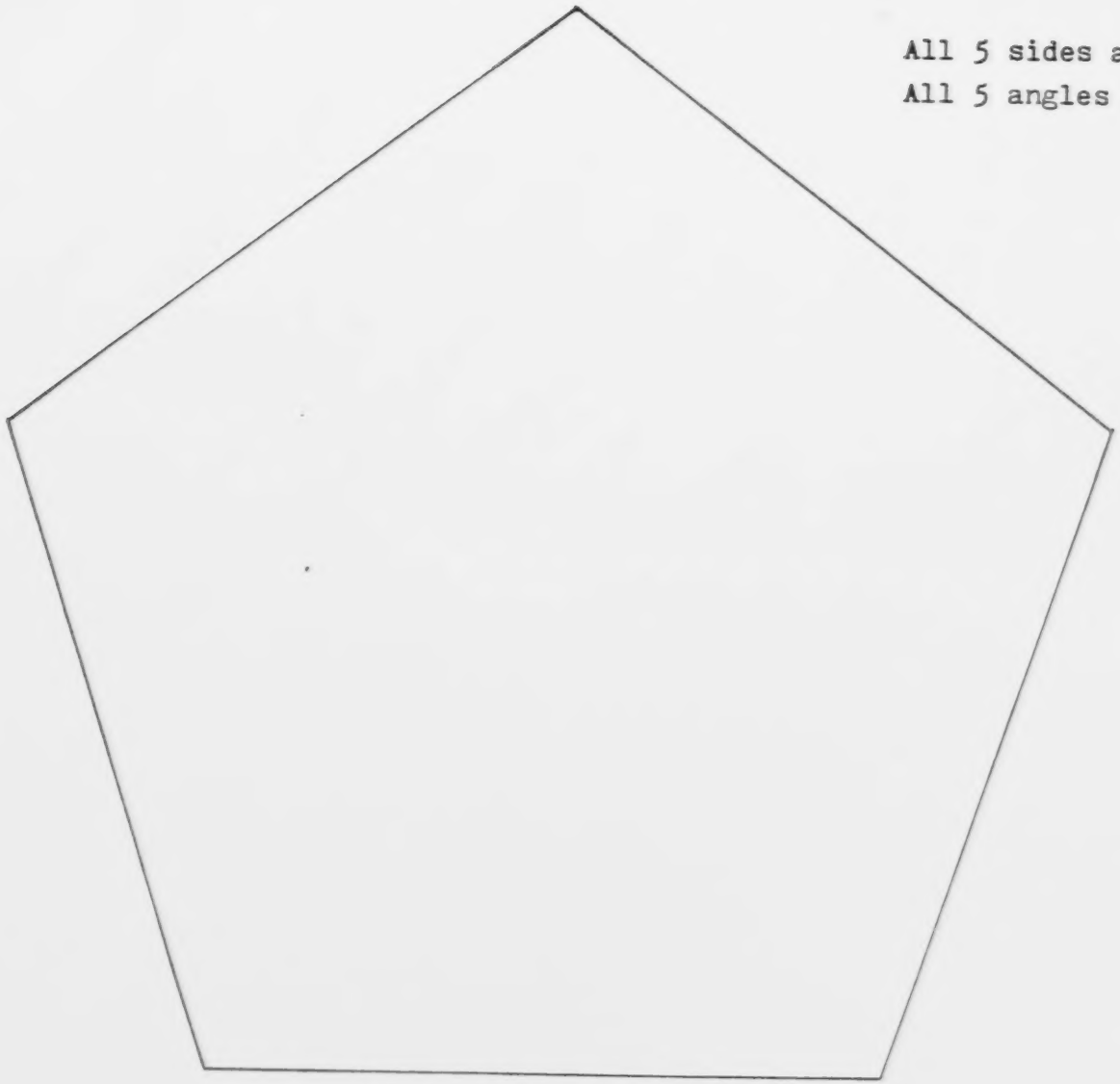
The square must rest on one point.

All 3 circles touch at the same place.



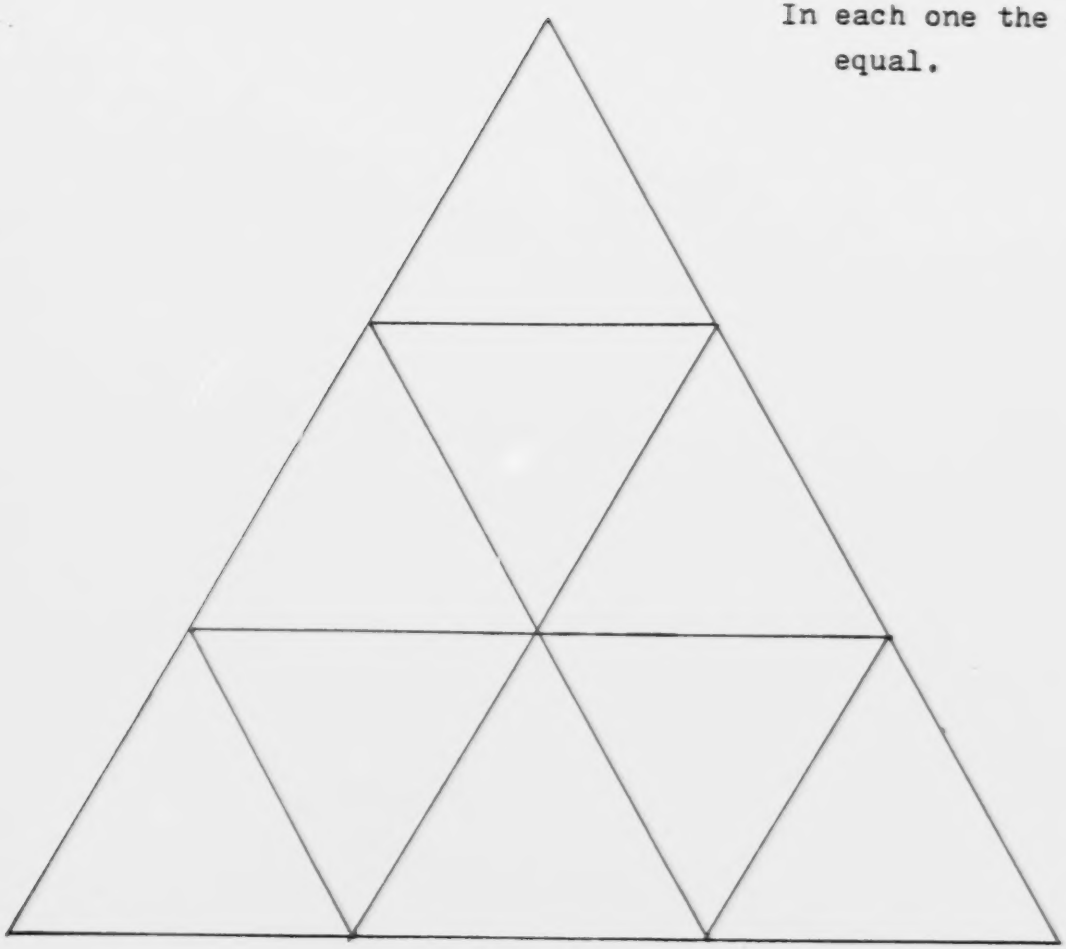


PENTAGON



All 5 sides are equal.
All 5 angles are equal.

All 9 small triangles are identical. In each one the sides and angles are equal.



APPENDIX II

Name _____ Age: Yrs. _____ Mo. _____

1. Circle the 90° angle.

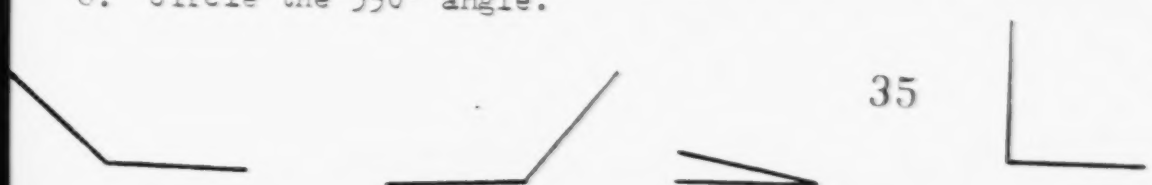
2. Circle the 45° angle.

3. Circle the 10° angle.

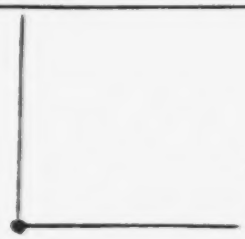
4. Circle the 135° angle.

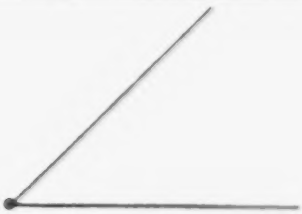
5. Circle the 270° angle.

6. Circle the 350° angle.



Finish drawing these angles so that they match perfectly the angle already drawn.





Finish drawing these lines so that they are <u>exactly</u> the same length.

EXAMPLE:

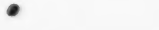
1.

2.

3.

4.

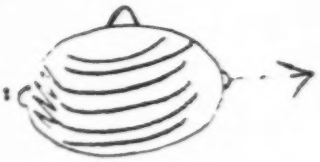
5.

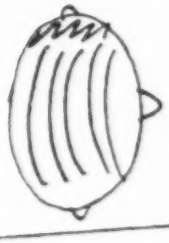


6.

Spin Oscar 90° to the right.

EXAMPLE:





Spin Oscar 45° to the left.

Spin Oscar 180° to the right.